A. COVER SHEET

Water Use Efficiency Program
Proposal Solicitation Package

1. Specify: agricultural project or urban project; individual or joint application

2. Proposal Title: **Demonstration Facilities Improvement at ITRC to partially address all of the CALFED Quantifiable Objectives**

3. Principal applicant: **California Polytechnic State University Irrigation Training and Research Center**

4. Contact: **Dr. Stuart Styles Director**

5. Mailing Address: **Dr. Stuart Styles - BRAE/ITRC Cal Poly State University 1 Grand Avenue San Luis Obispo, CA 93407**

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8. E-mail: **sstyles@calpoly.edu**

9. Funds requested: **$500,000**

10. Cost Share: **$632,585**

11. Duration: **July 2001 to June 2004**

12. State Assembly/Senate districts and Congressional Districts where project is to be conducted: **Affects all irrigated portions of CA**

13. Location and geographic boundaries of the project: **State of California**

14. Name and signature of official representing applicant. By signing below, the applicant declares the following:
    - the truthfulness of all the representations in the proposal;
    - the individual signing the form is authorized to submit the application for applicant;
    - the applicant will comply with contract terms and conditions identified in Section 11 of PSP.

Dr. Stuart W. Styles February 13, 2001

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B. SCOPE OF WORK

1. Abstract

This is a proposal for a demonstration facilities project for the Cal Poly Irrigation Training and Research Center (ITRC). This proposal addresses "all" of the CALFED Quantifiable Objectives (QOs) by assisting irrigation districts with their implementation of QOs. Cal Poly ITRC is proposing a **$500,000** project to improve the existing teaching facilities. The project will help with the expansion of a state-of-the-art water measurement testing facility and the addition of office space for students being trained in irrigation district operations.

2. Statement of Critical Issues

Training of irrigation professionals will be a cornerstone of the implementation of the proposed CALFED QOs. This includes irrigation district personnel, irrigation engineers/planners, and regulatory personnel. The ITRC is uniquely qualified to provide the training. In addition, training of competent and qualified Cal Poly students will be essential for the future of irrigated agriculture.

3. Nature, Scope, and Objectives

Plans have been made for expansion and improvement of the teaching facilities at ITRC. The following is a brief summary of the facilities and the planned improvements.

a. Water Delivery Facility

- *Components* - The Water Delivery Facility has a one acre reservoir, 11 pumps of various design powered by a 225Kva supply and an 80 HP natural gas engine. The pumps can be used to supply three canals; one 660 ft. with 6 pools with a maximum flow rate of 2000 GPM, and two 300 ft. canals each with a flow capacity from 3000 to 4000 GPM. Additional features of the facility include state-of-the-art SCADA (Supervisory Control and Data Acquisition) systems, modern RTUs (Remote Terminal Units) at 3 gates, redesigned gates on some structures, and a computer control system for this facility.

- *Classes using facility* - BioResource and Agricultural Engineering (BRAE) 128, 216, 236, 324, 328, 340, 405, 414, 425, 438, 440, 492, 531, 533.

- *Size and scope of facilities* - Total area is approximately 5 plus acres, including a 2 acre pond with a storage capacity of 15 acre-feet.

- *Investment in fields/facilities to date* - Estimated cost $1,200,000. (Most of this facility has been developed with funds from non-university sources.)

- *Future needs for fields/facilities* - Indoor hydraulic testing facilities, hydraulic flume, weighing tank, and an outdoor irrigation equipment/system testing space. A California Energy Commission (CEC) grant for $512,585 was obtained in 2000 by ITRC to provide testing of new electronic flow measurement equipment. The CEC grant did not cover expenses for demonstration facility improvements. It is estimated that an additional **$200,000** is needed to pay for the new facilities.

b. Merriam Irrigation Practices Field

- *Components* - The Merriam Irrigation Practices Field is used for instruction in BRAE irrigation classes, and for training of industry/government personnel. Improvements include: a dedicated water supply connected to Drumm reservoir, two underground pipeline water distribution networks, a canal containing multiple water measurement devices, a runoff return-flow system, an upgraded linear move sprinkler system, a complete set of modern drip system filters, upgraded CIMIS weather station instrumentation, improved fertigation equipment, and soil moisture sensors installed throughout the field.

- *Classes* - BRAE 128, 236, 340, 405, 414, 438, 440, 492, 531, 533.

- *Size and scope of facilities* - This area is identified as field C-22 and C –22 annex which includes the area between the east fence of field C-22 and the Brizzolaro Creek and the west fence of C-22 and the parking lot the pump location below drum reservoir. The total area is estimated to be 3 acres.

- *Investment in fields/facilities to date* - The replacement cost of this facility is estimated at $1,000,000. (Most of this facility has been equipped with non-university funds.) In 1999, the field's pasture and buffer strip was re-graded and seeded at a cost of $25,000.

- *Future needs for fields/facilities* - Sub-surface drip demonstration area for landscape irrigation. Student Lab facilities for sprinkler performance. Power supply for water

measurement channel. It is estimated that **$50,000** is need to pay for the new facilities.

c. Lab 2 - Water Lab

- *Components* - Lab 2 is equipped with a hydraulic flume, a drainage model and various irrigation controllers and equipment to demonstrate measurement and control techniques. Irrigation and water equipment specifically related to water quality and analysis will be added to the existing facility.

- *Classes* - BRAE 236, 340, 405, 414, 438, 440, 492, 531, 533.

- *Size and scope of facilities* - Lab space for 25 plus students, plus storage in lab-prep areas.

- *Investment in fields/facilities to date* - Re-modeled in 1989, $100,000. (Most of this facility was developed with non-university funds.)

- *Future needs for fields/facilities* - Floor drain for hydraulic flume and sand tank, computer network connections. It is estimated that **$25,000** is needed for the improvements to the Lab 2 Water Lab.

d. ITRC Irrigation Training & Research Center

- *Components* - This was all purchased and constructed with outside funds. Equipped with a conference room, offices for full-time staff, graduate student offices, ITRC office.

- *Classes* - BRAE 236, 340, 405, 414, 438, 440, 492, 531, 533. Service for all CAGR

- *Size and scope of facilities* - 4,000 square feet of offices (faculty, staff and graduate student, student help), training room, storage.

- *Investment in fields/facilities to date* - $600,000. (This facility was developed with outside funds.)

- *Future needs for fields/facilities* More graduate student offices, staff offices, storage space. ITRC has proposed construction of a second floor in the adjacent lab (Lab 3). The costs to install the second floor in Lab 3 are estimated at **$225,000**.

In addition to being used by students at Cal Poly in regular classes, these facilities are also utilized for the irrigation classes for professionals. The following is a list of classes that will continue to use these facilities:

Water Delivery Modernization Training.
The successful "School of Irrigation for Irrigation Districts", has been held annually in the Fall at ITRC. This school provides two sets of classes; one for irrigation district operators, and another for managers and engineers. The classes vary from 1-2 days in length each, and cover topics such as:

- Flow measurement in canals
- Flow measurement in pipelines
- General principles of modernization
- Advanced concepts in canal modernization
- SCADA systems
- Determining district water balances
- Hand Held Data Recorders

Water Conservation Coordinator Training
The Agricultural Water Management Council and USBR require a designated water conservation coordinator from each irrigation district as part of their water management plan. The ITRC has developed materials and curriculum to assist the water conservation coordinators in developing and implementing effective water management plans. This 1-2 day training will be updated annually and provided as part of the Irrigation District Training Classes.

Annual Designer/Manager School of Irrigation.
This 2-week school has been developed and held at the ITRC for the last 10 years. This is an excellent program for persons who are designing and managing on-farm irrigation systems. There is no other such technical program available for these people in California. The need is very basic: Unless irrigation designers know how to properly design an irrigation system for good uniformity and simple management, on-farm irrigation efficiencies will be low. Typically, irrigation system designers have no formal university irrigation training and they must have this type of class available in order to supplement their rudimentary hands-on, on-the-job training. ITRC works closely with The Irrigation Association in its Designer Certification program to help certify designers; these classes help designers prepare for those exams.

This proposal will help support the continuation of the Annual Designer/Manager School of Irrigation. The goals are directly in line with CALFED's QOs to improve on-farm irrigation, reduce drainage problems, and enhance groundwater and surface water qualities. Other funding partners for this program may include the California Energy Commission, and contributions from private industry.

Classes provided in this school will include:

- Basic soil/plant/water relationships (1 day)
- Basic hydraulics (1 day)
- Basic pumps (1 day)
- Advanced pumps (2 days)
- Row crop drip irrigation (1 day)
- Fertigation (1 day)
- Drip system design (3 days)
- Irrigation scheduling, salinity, and drainage (2 days)
- Sprinkler irrigation design (2 days)

On-Farm Irrigation Evaluation.

In the early 1980's, the ITRC developed, on behalf of the Water Conservation Office of the Calif. DWR, a 2.5 day class on Irrigation Evaluation techniques. That class has been offered twice per year since then with DWR funding. This class will continue to make a very important contribution to water conservation in California. It provides a standardized format for definitions of Irrigation Efficiency, and for the procedures to be used in measuring Irrigation Efficiency and Distribution Uniformity for on-farm irrigation. As a result of this standardized training, it is now much easier for persons to communicate regarding irrigation efficiency. Without continued training, there will be a wide mix of varying perceptions of what irrigation efficiency is, and how it can be measured. A clear perception is absolutely necessary if valid water conservation programs within districts are to be developed.

4. Methods, Procedures, and Facilities

Construction of the improvements will be done entirely by students and supervised by professional engineers. This is an action-specific proposal that allows for the improvement of training facilities at Cal Poly ITRC.

5. Schedule

It is anticipated that the funds would be spent within one year with the majority of the funds (over 75%) being spent during the summer of 2001.

6. Monitoring and Assessment

It is anticipated that the training program and the new facilities will help irrigation districts with their ultimate decrease in available water supplies. Since most irrigation district management has realized that they must modernize in order to help their farmers survive, these training classes will be essential to help districts deal with the changes.

C. OUTREACH, COMMUNITY INVOLVEMENT, AND INFORMATION TRANSFER

1. Outreach

The training classes will be provided to some irrigation districts that traditionally have not been able to afford for irrigation professionals to review the district operations. Some irrigation districts have been set up and operated for almost 100 years with a simple, yet flexible water supply. These districts will be the ones most impacted with tightening water supplies.

2. Training, Employment, and Capacity Building

The ITRC proposal will provide training to irrigation district personnel. It is estimated that about 400 persons receive training every year. The ITRC employs 30 persons. About 20 of these are students who are provided with an excellent opportunity to receive professional engineering training. This proposal will directly increase the base of students trained in irrigated agriculture who will contribute professionally after graduation in improving water management in California.

3. Information Dissemination

a. A summary report will be published on the Cal Poly ITRC web pages (www.itrc.org).
b. Articles will be supplied to USBR Mid-Pacific Region Water Conservation Office newsletter.
c. Articles will be supplied to Calif. DWR Water Conservation Office newsletter.

D. QUALIFICATIONS

1. Resumes

The resume for Dr. Stuart Styles is attached. Others who will be participating in teaching classes include Dr. Charles Burt, Keith Crowe, Andy Mutziger, Dan Howes, and Sara Miller. Resumes for these individuals are also attached.

2. External Cooperators

There are no external cooperators scheduled for this program.

3. Partnerships

ITRC has been awarded a contract to perform Task 5 of the California Energy Commission project titled "Optimization of Water and Energy Resources Associated with Irrigation Water Delivery and Management". The funding for demonstration facilities would be folded into the CEC project by helping to fund some of the testing facilities required. The total contract amount for Task 5 of the CEC study is **$512,585**.

Task 5 deals with one of the most critical components of an irrigation project -- water measurement. The contract requires the use of facilities to test and monitor flow measurement equipment. Rather than contract with an out-of-state laboratory to perform the testing, ITRC would like to construct new facilities at the existing Water Deliver Facility located next to Drumm Reservoir. This area has been reserved by the Cal Poly Master Plan for ITRC expansion when the Bull Test Unit is moved.

Some specific challenges for flow rate management are:

- In the Sacramento Valley, many irrigation districts deliver water to farmers by gravity at high flow rates per turnout, at locations with almost no pressure loss available at the turnouts. Most of these turnout deliveries are not metered - the present flow metering technology is either too expensive or unsuitable for the conditions of high flow rates, very low pressure loss, and dirty water. Most of the canal water was originally pumped out of the Sacramento River even though the final deliveries are by gravity, which means that on-farm water measurement and management have a direct impact on pumping costs.

- Good flow rate and volumetric water measurement in drains and rivers is extremely sparse, partly because of the high expense of instrumenting such sites. Some of the new electronic technologies, coupled with flow conditioning, may have widespread applications here.

- Large measurement flumes for irrigation districts can cost $100,000 +, each. Perhaps some of the new technologies can perform the measurement for considerably less, with the same degree of accuracy.

Most agricultural irrigation districts are very interested in modernizing to support their farmer customers, as evidenced by strong ITRC activity with at least 20-30 irrigation districts per year.

However, as noted above, significant technical issues remain, on which significant research is required, to improve the flexibility and reliability of water deliveries. Part of this research targets two aspects of energy conservation. First, it targets an improvement of energy efficiencies that are impacted by irrigation today. Second, it targets future increases in energy consumption (due to groundwater pumping) by farmers who will turn to increased groundwater usage when to shift to more modern on-farm irrigation methods.

Magnetic and ultrasonic flow measurement technologies have been installed in a few irrigation districts over the past 5 years. However, these applications have all been on large pipelines or large canals. With a cost that varies from about $5,000 - $30,000 per site (material only), they are prohibitively expensive for permanent use on individual farm turnouts. Doppler meters have been used successfully for large river and ocean flow rate measurements, but are not used in irrigation districts. Vortex shedding, to the knowledge of ITRC, is a principle that has never been used in irrigation districts. However, vortex shedding is commonly used in the petro-chemical industries.

Present doppler, vortex shedding, magnetic and ultrasonic technologies sometimes guarantee an accuracy of better than 2%, whereas a ±5% accuracy would be excellent for a farm turnout. However, the 2% accuracy on large scale has been questioned. There is a need to research devices using these technologies for large-scale measurement, and to also investigate their application on smaller turnouts.

There is some evidence that magnetic and ultrasonic technology can work economically on farm turnouts - private companies in Australia have recently promoted low-cost magnetic and ultrasonic meters to replace the old "Dethridge" water wheels that used to be popular in Victoria, Australia. Together with USGS, the USBR, and a manufacturer, ITRC is presently investigating the use of some new Doppler meter technologies in a canal at the Water Delivery Facility at Cal Poly; this technology may be applicable for smaller turnouts and large canals.

This research would examine these technologies to determine how well they work and what, if any modifications could be made to reduce the cost. ITRC will meet with the various U.S. and Australian manufacturers of magnetic, vortex shedding, doppler, and ultrasonic meters to determine the suitability of their devices in their current configuration for flow measurement on both large canals, and in pipelines and small farm turnouts. The characteristics (including cost, robustness, and accuracy over a range of conditions) of various "off-the-shelf" units will first be tested both in the lab and in the field. In addition, brainstorming will be conducted with interested manufacturers to develop modified units that may reduce cost but still provide a "reasonable" accuracy.

Several manufacturers have already expressed an interest in donating equipment for the new facilities including Sutron (about **$100,000**) and Floway Pumps (about **$20,000**).

E. COSTS AND BENEFITS

1. Budget Summary
The following is the estimated breakdown of the budget for 1 year.

Demonstration Facilities Improvement at ITRC

	WDF	IPF	Lab 2 - Water Lab	ITRC	Totals
salaries and wages	$39,820	$22,190	$6,800	$55,480	$124,290
fringe benefits	$6,004	$3,502	$1,073	$8,985	$19,564
supplies	$6,028	$11,345	$10,646	$102,202	$130,221
equipment	$130,000	$0	$0	$0	$130,000
travel	$0	$0	$0	$0	$0
other (direct costs)	$18,148	$12,963	$6,482	$58,333	$95,925
total	$200,000	$50,000	$25,000	$225,000	**$500,000**

Cost Share Component:

Task 5 CEC	$512,585 (to be implemented over 3 years)
Sutron	$100,000
Floway Pumps	$ 20,000

	$632,585

2. Budget Justification
Salaries and overheads used in developing this cost estimate were based on existing State contracts with the California Energy Commission and the Cal Poly ITRC completed in 2000.

3. Benefit Summary
Improvements of the ITRC training facilities is targeted towards the end-users (water district personnel and farmers) of the information, and towards individuals and organizations (such as irrigation dealerships) that have a multiplying effect. It addresses the "how to" questions that always accompany policy changes.